Interface Requirements Document

between

EOSDIS Core System (ECS)

and

NASA Institutional Support Systems (NISS)

CCR 505-01-30-011-C incorporated

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May 1995

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

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Preface

This document is a formal contract deliverable with an approval code 1. It requires Government review and approval prior to acceptance and use. Changes to this document also require Government approval prior to acceptance and use. Changes to this document shall be made by document change notice (DCN) or by complete revision.

This document is under ESDIS Project Configuration Control. Any questions or proposed changes should be addressed to:

Configuration Manage~~men~~ment Office

Çode 505

GSFC

Greenbelt, Md.

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Abstract

The Earth Observing System Data and Information System (EOSDIS) Core System (ECS) involves the collection and distribution of data from space and ground based measurement systems to provide the scientific basis for understanding global change. Using ECS as their window to the EOSDIS, the international science community is able to access data from a distributed archive in the United States and from other international Earth Science support systems. To accomplish this mission, it is necessary for ECS to interface with a wide variety of external systems. This document represents the ECS requirements to provide an interface between ECS and the NASA Institutional Support Systems.

The ECS contractor team used the process described in the ECS Methodology for Definition of External Interfaces document to develop these interface requirements. Level 2 and Level 3 Requirement Specifications were used in the methodology to evolve this formal Interface Requirement Document (IRD).

~~This document supersedes the following preliminary ECS IRDs which were delivered in August 1993:~~

- ~~193-219-SE1-007, Interface Requirements Document Between ECS and Network Control Center;~~
- ~~193-219-SE1-016, Interface Requirements Document Between ECS and Flight Dynamics Facility.~~

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Abbreviations and Acronyms

1. Introduction

1.1 Identification

This Interface Requirement Document (IRD), Contract Data Requirement List (CDRL) Item 039, whose requirements are specified in Data Item Description (DID) 219/SE1, is a required deliverable under the Earth Observing System Data and Information System (EOSDIS) Core System (ECS), Contract (NAS5-60000). It defines the ECS requirements for interfacing with the NASA Institutional Support Systems.

1.2 Scope

This IRD defines the ECS system requirements for interfacing with the NASA Institutional Support Systems. The NASA Institutional Support Systems are the Space Network (SN) (which includes the Tracking and Data Relay Satellite System [TDRSS] and the Network Control Center [NCC]), the Alaska Ground Station (AGS), the SvalbardNorway Ground Station (SGS)the Wallops Orbital Tracking Station (WOTS), and the Flight Dynamics Facility (FDF).., .and the NASA Communications (Nascom) Operational Local Area Network (NOLAN). The EPGS (EOS Polar Ground Station) includes SGS and AGS.

The requirements identified in this IRD are the Level 3-equivalent ECS requirements for interfacing with the NASA Institutional Support Systems. Detailed requirements specific to each EOS mission (AM-1, PM-1, etc.) will be defined in ECS Level 4 requirements. These mission-specific requirements will be documented in the ECS Segment Requirements Specification, DID 304/DV1.

NASA Institutional Support System requirements for interfacing with ECS are not covered in this IRD; these requirements will be defined in the Detailed Mission Requirements (DMR) documents for the various EOS missions.

This document supersedes the following preliminary ECS IRDs which were delivered in August 1993:

- 193-219-SE1-007, Interface Requirements Document Between ECS and Network Control Center
- 193-219-SE1-016, Interface Requirements Document Between ECS and Flight Dynamics Facility

This IRD will be approved under the signature of the ESDIS Project Manager.

1.3 Purpose and Objectives

The purpose of this IRD is to formally acknowledge the ECS interfaces with the NASA Institutional Support Systems and to define interface requirements that will be tested during ECS integration. In the preparation of this IRD, Level 3-equivalent interface requirements were derived and extracted from the Functional and Performance Requirements Specification for the EOSDIS Core System.

This document also acknowledges the applicability of existing interface documentation which has already been developed by the NASA Institutional Support Systems. ECS will adopt and conform to these existing ICDs and established interface procedures.

1.4 Status and Schedule

This document has been approved by the ECS Contractor Configuration Control Board (CCB) as a final IRD. As a formal contract deliverable with approval Code 1, this document requires Government review and approval prior to its acceptance and use. At the Government's option, this document may be designated to be under full Government CCB control.

Changes may be submitted for consideration by Contractor and Government CCBs under the normal change process at any time.

1.5 Document Organization

This Interface Requirements Document is organized as described below

Section 1	Introduction - Introduces the IRDs scope, purpose, objectives, status, schedule, and document organization.
Section 2	Related Documentation - Provides a bibliography of reference documents for the IRD organized by parent, applicable, and information subsections.
Section 3	Systems Description - Provides an overview of both systems and a discussion of the system components involved in the interface.
Section 4	Functional and Performance Interface Requirements - Requirements are sorted for presentation by denoting functional or performance type.
Section 5	Interface Control Documentation Plan - Identifies and summarizes the ICDs that will spawn from this IRD.

2. Related Documentation

2.1 Parent Documents

The following documents are the parents from which this document's scope and content derive:

193-208-SE1-001	EOSDIS Core System Project, Methodology for Definition of External Interfaces
301-CD-002-003	EOSDIS Core System Project, System Implementation Plan for the ECS Project
GSFC 423-41-02	Goddard Space Flight Center, Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System, June 2, 1994
GSFC 423-10-01-1	Goddard Space Flight Center, Earth Science Data and Information System (ESDIS) Project -- Level 2 Requirements, May 21, 1993
GSFC 423-41-01	Goddard Space Flight Center, EOSDIS Core System Statement of Work, June 2, 1994

2.2 Applicable Documents

The following documents are referenced herein and are directly applicable to this document. In the event of conflict between any of these documents and this document, this document shall take precedence.

505-10-33	Goddard Space Flight Center, Detailed Mission Requirements (DMR) for the AM-1 Spacecraft, ~~July 1994~~*November 1996*
~~502-ICD-JPL/GSFC~~	~~Goddard Space Flight Center/MO&DSD, Interface Control Document Between the Jet Propulsion Laboratory and the Goddard Space Flight Center for GSFC Missions Using the Deep Space Network, January 1994~~
530-ICD-NCCDS/MOC	Goddard Space Flight Center/MO&DSD, Interface Control Document Between the Goddard Space Flight Center Mission Operations Centers and the Network Control Center Data System, ~~October 1993~~*April 1996*
~~530-ICD-NCCDS/POCC~~	~~Goddard Space Flight Center/MO&DSD, Interface Control Document Between the Goddard Space Flight Center Payload Operations Control Centers and the Network Control Center Data System, March 1992~~

530-DFCD-NCCDS/POCC	Goddard Space Flight Center/MO&DSD, Data Format Control Document Between the Goddard Space Flight Center Payload Operations Control Centers and the Network Control Center Data System, Revision 1, December 1994
534-OIP-NCC/STDN Users	Goddard Space Flight Center/MO&DSD, Operations Interface Procedures Between the Network Control Center (NCC) and the Spaceflight Tracking and Data Network Users, February 1993
541-185	Goddard Space Flight Center/MO&DSD, Nascom Operational Local Area Network (NOLAN) Interface Control Document, October 1993
553-FDD-91/028	Goddard Space Flight Center/MO&DSD, Flight Dynamics Division (FDD) Generic Data Product Formats Interface Control Document, June 1991
560-EDOS-0211.0001	Goddard Space Flight Center/MO&DSD, Interface Requirements Document Between EDOS and the EOS Ground System (EGS) Elements, Preliminary, February 1994 (DCN 006)Revision 1, August 1996
GSFC 423-35-01	Goddard Space Flight Center/MO&DSD, EOS Data and Operations System (EDOS) and EOS Communications (EBnetEcom) Requirements, March 17, 1992 (through CH22)
540-022	Goddard Space Flight Center/MO&DSD, Earth Observing System (EOS) Backbone network Communications (EBnetEcom) Interface Requirements Document, March, 1993*(update)*
560-EDOS-0915.0003	Earth Observing System (EOS) Data and Operations System (EDOS) and EOSDIS Backbone networkCommunications (EBnetEcom) Traffic Model, February 1994*(update)*

2.3 Information Documents

The following documents, although not directly applicable, amplify or clarify the information presented in this document, but are not binding.

	Goddard Space Flight Center, Earth Observing System Mission Operations Concept Document, March 1993
604-CD-001-003	EOSDIS Core System Project, Operations Concept for the ECS Project: Part 1 -- ECS Overview, Final Draft
604-CD-002-001	EOSDIS Core System Project, Operations Concept for the ECS Project: Part 2B -- ECS Release B, Annotated Outline
604-CD-001-004	Operations Concept for the ECS Project: Part 1 - ECS Overview

604-CD-004-001	ECS Operations Concept for the ECS Project: Part 2, FOS
604-CD-002-003	ECS Operations Concept for the ECS Project: Part 2B - ECS Release B
505-41-14	IRD Between ECS and Tropical Rainfall Measuring Mission (TRMM)
194-219-SE1-019505-41-15	IRD Between ECS and EOS AM-1 Flight Project
534-OCD-STDN	Goddard Space Flight Center/MO&DSD, STDN Operations Concepts 1996, March 1992
534-UGD-SN-RTOPS	Goddard Space Flight Center/MO&DSD, Space Network User's Guide for Real-Time Operations, March 1993
540-028	Goddard Space Flight Center/MO&DSD, Earth Observing System (EOS) Communications (EBnetEcom) Operations Concept Document, March 1993
560-EDOS-0106.0002	Goddard Space Flight Center/MO&DSD, Earth Observing System (EOS) Data and Operations System (EDOS) Operations Concept, December 1992
560-EDOS-0211.0003	Goddard Space Flight Center/MO&DSD, Interface Requirements Document Between EDOS and the TDRSS Ground Terminal (TGT), December 1992 (DCN 001)(DCN 008) March 1996
560-EDOS-0211.0004	Goddard Space Flight Center/MO&DSD, Interface Requirements Document Between EDOS and EBnetEcom, March 17, 1994 (DCN 007)
560-EDOS-0230.0001	Goddard Space Flight Center/MO&DSD, Earth Observing System (EOS) Data and Operations System (EDOS) Data Format Requirements Document (DFRD), December 1992)*DCN 9 August 1996*
ICD-106	Martin Marietta Corporation, Interface Control Document (ICD) Data Format Control Book for EOS-AM Spacecraft, January 1997April 1994
STDN No. 101.1	Goddard Space Flight Center/MO&DSD, STDN User's Guide (Basic)
STDN No. 101.2	Goddard Space Flight Center/MO&DSD, Space Network User's Guide, September 1988
STDN No. 117	Goddard Space Flight Center/MO&DSD, Tracking and Data Relay Satellite System (TDRSS) Network Functional Description

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3. Systems Descriptions

3.1 Systems Relationship Overview

The ECS and the NASA Institutional Support Systems will work together to provide operational support for EOS missions. Figure 3-1 presents a context diagram for the interfaces between the ECS and the NASA Institutional Support System elements.

The ECS/NASA Institutional Support Systems interfaces are summarized in Table 3-1. Throughout this section, the data flows are identified by the numbers used in this table. These data flow numbers are enclosed in brackets after the first reference to the data flow. The bracketed numbers in Figure 3-1 also are cross-referenced to the data flow numbers in Table 3-1.

The SN, AGS, SGS, and WOTS systems will provide tracking, telemetry, and command (TT&C) support for EOS spacecraft. [Table 3-1, Data Flows 1, 2, 11 and 12~~and 8 through 16~~] Specific data rate requirements are defined in the applicable mission DMR documents. The NCC will be responsible for providing the interface for management, scheduling, control, and fault isolation of the SN. [Table 3-1, Data Flows 3 through 7] The Wallops Orbital Tracking Information System (WOTIS)~~NCC also~~ will be the point-of-contact for scheduling contingency/emergency support from the AGS, SGS, and WOTS~~. [Table 3-1, Data Flows 17 and 18] Guidelines and procedures for scheduling AGS, SGS, and WOTS for contingency/emergency support are documented in the applicable documents listed in Section 2.2.~~ ECS scheduling of the AGS, SCS, and WOTS for S-band contingency support is handled procedurally by operations personnel. No ECS system software will be developed to automate this scheduling function.

FDF will interface with ECS to provide orbit and attitude support for EOS spacecraft by monitoring spacecraft attitude and navigation system performance and providing orbit and attitude products to support ECS flight operations and science processing. [Table 3-1, Data Flows 19 through 24] FDF also may provide orbit and attitude determination for selected EOS spacecraft.

~~The NOLAN will be used to transport science and ancillary data from NASA data processing facilities (such as the GSFC Sensor Data Processing Facility [SDPF]) to the ECS SDPS for certain NASA missions (such as the Tropical Rainfall Measuring Mission [TRMM]). For more information, refer to the IRD Between ECS and TRMM. [Table 3-1, Data Flow 25]~~

Data flows between ECS and the NASA Institutional Support Systems which have been identified in the Functional and Performance Requirements Specification for the ECS are listed in Table 3-1. Detailed descriptions of these data flows may be found in the reference documents listed in Section 2, or in ICDs which will be developed for these interfaces. Refer to Section 5 for identification and schedules for these ICDs.

Sections 3.2 through 3.8 provide overall views of the ECS, the AGS, the SGS, SN, the WOTS, and the FDF~~, and NOLAN.~~ Sections 3.9 and 3.10 provide descriptions of EBnet~~Ecom~~ and

EDOS. The purpose of these overviews is to set the context for understanding the ECS interfaces with these systems.

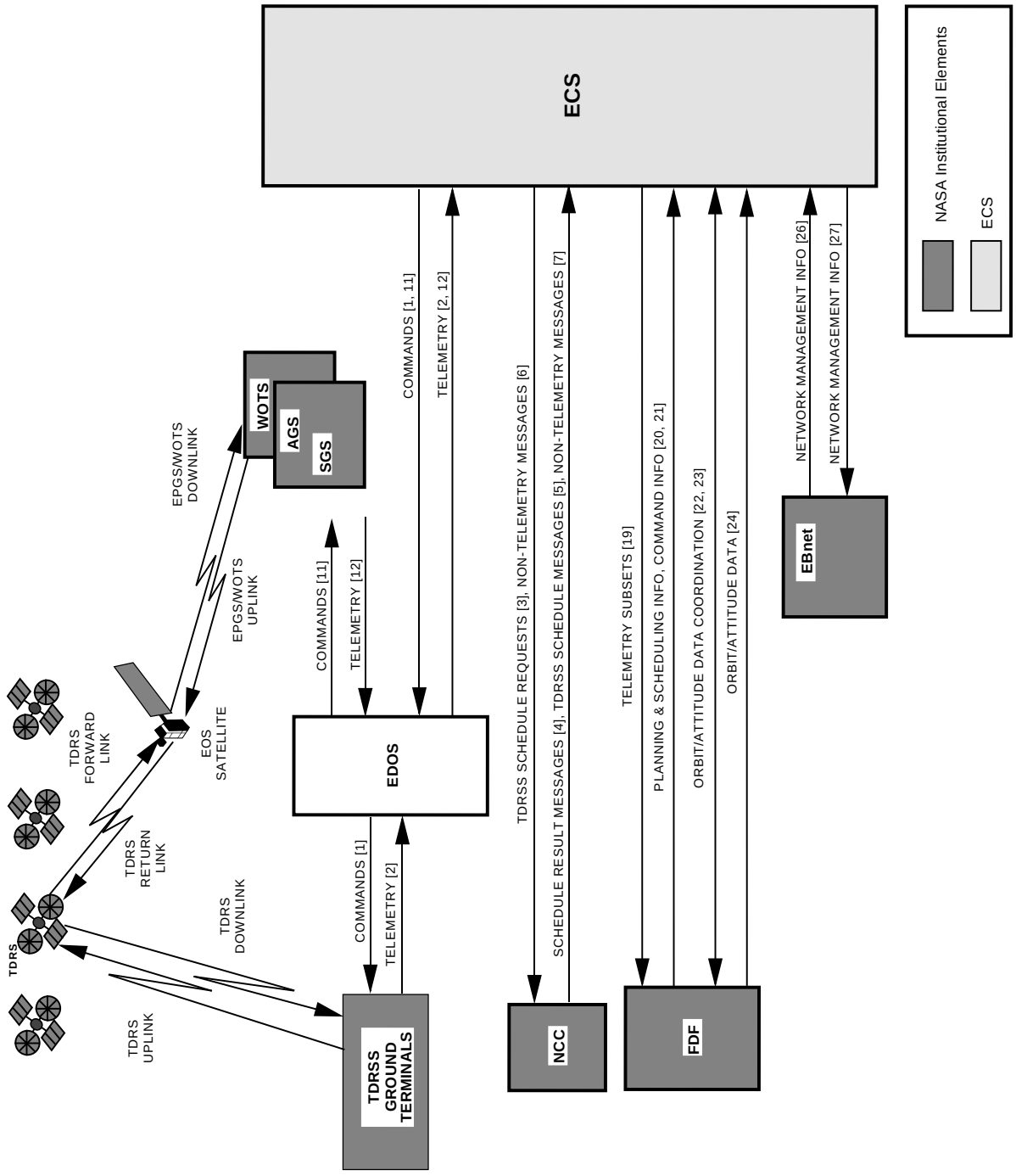

Figure 3-1. ECS/NASA Institutional Systems Interface Context

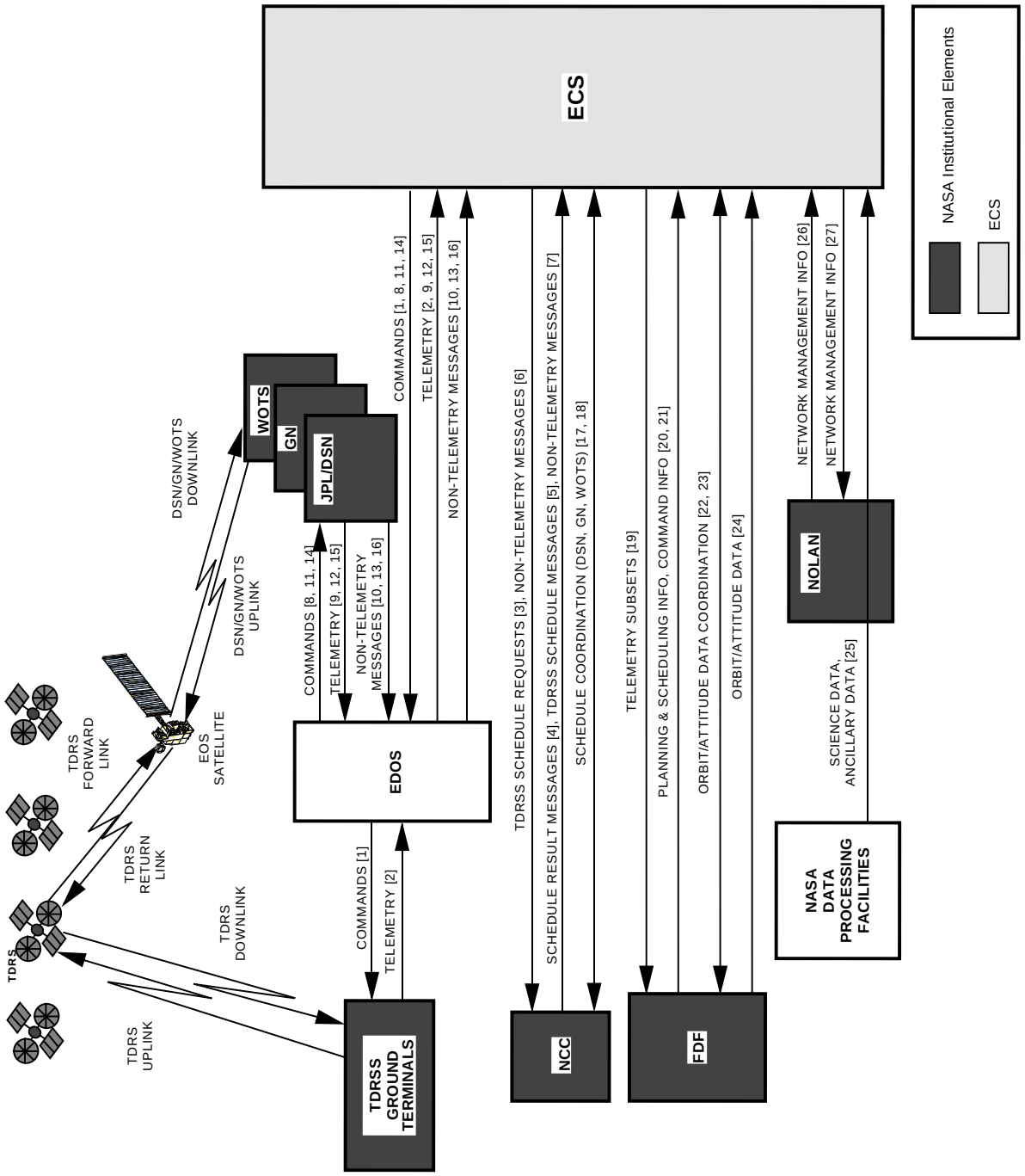

Figure 3-1. ECS/NASA Institutional Systems Interface Context

Table 3-1. ECS/NASA Institutional System Data Flows (1 of 4)

From	To	Data Flow	Description	Communications Link
ECS	TDRSS (via EDOS)	[1] Commands	EOS spacecraft commands	EBnet~~Ecom~~
TDRSS	ECS (via EDOS)	[2] Telemetry	EOS spacecraft telemetry	EBnet~~Ecom~~
ECS	NCC	[3] TDRSS Schedule Requests	Requests for additions or deletions to the TDRSS schedule for the support of EOS missions. Includes messages such as Schedule Add Requests and Schedule Delete Requests.	EBnet~~Ecom~~
NCC	ECS	[4] Schedule Result Messages	Notification of acceptance or rejection of a TDRSS Schedule Request. If rejected, includes the reason for the rejection.	EBnet~~Ecom~~
NCC	ECS	[5] TDRSS Schedule Messages	TDRSS schedules or schedule changes involving TDRSS support for EOS spacecraft. Includes messages such as User Schedules and Schedule Deletion Notifications.	EBnet~~Ecom~~
ECS	NCC	[6] Non-telemetry Messages	Requests for TDRSS reconfiguration or status. Includes messages such as Ground Control Message Requests, User Performance Data Requests, Communications Test Messages, and Acknowledgments.	EBnet~~Ecom~~

Table 3-1. ECS/NASA Institutional System Data Flows (2 of 4)

From	To	Data Flow	Description	Communications Link
NCC	ECS	[7] Non-telemetry Messages	TDRSS reconfiguration and status information. Includes messages such as Ground Control Message Dispositions, Acquisition Failure Notifications, User Performance Data, Time Transfer Messages, Communications Test Messages, and Acknowledgments.	EBnetEcom
ECS	AGS, SGS, WOTS (via EDOS)	[11] Commands	EOS spacecraft commands	EBnetEcom
AGS, SGS, WOTS	ECS (via EDOS)	[12] Telemetry	EOS spacecraft telemetry	EBnetEcom
AGS, SGS, WOTS	ECS (via EDOS)	[13] Non-telemetry Messages	Data which allows the ECS to monitor command/telemetry operations. May include data such as test data or status messages, if available.	Ecom

Table 3-1. ECS/NASA Institutional System Data Flows (3 of 4)

From	To	Data Flow	Description	Communications Link
ECS	WOTS (via EDOS)	[14] Commands	EOS spacecraft commands	Ecom
WOTS	ECS (via EDOS)	[15] Telemetry	EOS spacecraft telemetry	Ecom
WOTS	ECS (via EDOS)	[16] Non-telemetry Messages	Data which allows the ECS to monitor command/telemetry operations. May include data such as test data or status messages, if available.	Ecom
ECS	WOTIS	[17] Schedule Coordination	Requests for contingency/ emergency support for EOS spacecraft from the AGS, SGS, or WOTS.	Low-speed communications, as defined in ICDs and Operations Interface Procedures.
NCC	ECS	[18] Schedule Coordination	Scheduling results for contingency/ emergency support for EOS spacecraft from the AGS, SGS, or WOTS.	Low-speed communications, as defined in ICDs and Operations Interface Procedures.
ECS	FDF	[19] Telemetry Subsets	EOS spacecraft telemetry subsets. Includes spacecraft attitude, navigation, and spacecraft maneuver data.	EBnetEcom
FDF	ECS	[20] Planning Aids	Predicted orbit, predicted ground track, EOS spacecraft user antenna view, predicted site acquisition tables, spacecraft maneuver information, etc. for EOS spacecraft and instruments.	EBnetEcom

Table 3-1. ECS/NASA Institutional System Data Flows (4 of 4)

From	To	Data Flow	Description	Communications Link
FDF	ECS	[21] Command Info	EOS spacecraft navigational and spacecraft maneuver parameters used for command data generation.	EBnetEcom
ECS	FDF	[22] Orbit/Attitude Notification/Request	Notification of orbit and/or attitude data quality checks, including requests for updated orbit and/or attitude information.	To be documented in FDF/ECS ICDs.
FDF	ECS	[23] Orbit/Attitude Notification/ Coordination	Notification of oOrbit and/or attitude data quality checking software and parameters, including coordination for providing updated orbit and/or attitude information.	To be documented in FDF/ECS ICDs.
FDF	ECS	[24] Orbit/Attitude Data	Orbit and attitude data (with associated metadata), consistent with EOS mission requirements.	EBnetEcom
NASA Data Processing Facilities	ECS	[25] Science Data, Ancillary Data, etc.	Science and ancillary (orbit/attitude)data for NASA spacecraft, also includes any required data schedules or coordination information, as required.	NOLAN
NOLAN	ECS	[26] Network Management Information	Information related to NOLAN faults, status, network performance, network utilization, security breaches, etc.	NOLAN or voice (contingency)
ECS	NOLAN	[27] Network Management Information	Notifications of ECS network security breaches.	NOLAN or voice (contingency)

3.2 EOSDIS Core System (ECS)

3.2.1 ECS Overview

The ECS, the EOS Data and Operations System (EDOS), and the EOSDIS Backbone Network ~~Communications~~ (EBnet~~Ecom~~) network are components of the EOSDIS. ECS supports the planning, scheduling, control, and analysis of U.S. EOS spacecraft and instruments. In addition to fully supporting the EOS mission, the ECS provides information management and data archive and distribution functions for other NASA Earth science flight missions, NASA instruments flown on non-NASA spacecraft, and for other NASA held Earth science data.

3.2.2 ECS Segments

ECS is composed of three segments defined to support three major operational areas: flight operations, science data processing, and communications/system management. The ECS segments are described below:

a. The Flight Operations Segment (FOS) manages and controls the U.S. EOS spacecraft and instruments. The FOS includes the EOS Operations Center (EOC), which is responsible for mission planning, scheduling, control, monitoring, and analysis in support of mission operations for U.S. EOS spacecraft and instruments. The ECS EOC is located at the Goddard Space Flight Center (GSFC). The FOS also provides investigator-site ECS software (the Instrument Support Terminal [IST] toolkit) to connect a Principal Investigator (PI) or Team Leader (TL) to the FOS in remote support of instrument control and monitoring. ~~(Investigator facilities are outside the FOS, but connected to it by way of the EOSDIS Science Network [ESN] or NASA Science Internet [NSI] Wide Area Networks [WAN].)~~

b. The Science Data Processing Segment (SDPS) provides a set of processing and distribution functions for science data and a data information system for the entire EOSDIS. The SDPS processes data from the EOS instruments to Level 1-4 data products. The SDPS also provides short- and long-term storage for EOS, other Earth observing missions, and other related data, software, and results, and distributes the data to EOSDIS users. The SDPS contains a distributed data and information management function and user services suite for the ECS, including a catalog system in support of user data selection and ordering. SDPS elements will be distributed at the following Distributed Active Archive Centers (DAACs):

   1. Goddard Space Flight Center (GSFC), Greenbelt, Maryland
   2. Earth Resources Observation System (EROS) Data Center (EDC), Sioux Falls, South Dakota
   3. Jet Propulsion Laboratory (JPL), Pasadena, California
   4. Langley Research Center (LaRC), Hampton, Virginia

5. University of Colorado, National Snow and Ice Data Center (NSIDC), Boulder, Colorado

6. University of Alaska, Alaska Synthetic Aperture Radar (SAR) Facility (ASF), Fairbanks, Alaska*

7. Marshall Space Flight Center (MSFC), Huntsville, Alabama

8. Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee*

*These DAACs have no ECS-provided product generation capability.

c. The Communications and System Management Segment (CSMS) provides overall ECS management of ECS ground system resources, provides communications/networking services for all ECS DAACsan extensive science data communications network, and manages the interfaces to the EBnetEcom EOSDIS Backbone Nnetwork, the NASA Communications (Nascom) Local Area Network (NOLAN), and the NASA Science Internet (NSI). The CSMS also includes the ESN, which consists of a dedicated internal ECS Wide Area Network (WAN) with circuits provided by the Program Support Communications Network (PSCN); also includes Local Area Networks (LANs) at each of the DAACs and the EOC to support ECS operations.; connections to International Partners (IPs); and interfaces at DAACs with Ecom, NOLAN, and NSI. The CSMS System Monitoringanagement & Coordination Center (SMC), along with local system management capabilities at DAAC sites and the EOC, provides system management services for ECS ground system resources. Most of the operations staff is considered part of the SDPS or FOS, including Local System Management (LSM) operators.

3.3 Space Network (SN) and Network Control Center (NCC)

The SN elements are the TDRSS and the NCC. The TDRSS ground segment consists of two TDRSS Ground Terminals (TGTs), the White Sands Ground Terminal (WSGT) and Second TDRSS Ground Terminal (STGT), located at the White Sands Test Facility in Las Cruces, New Mexico. The TDRSS space segment consists of a constellation of Tracking and Data Relay Satellites (TDRSs) in geosynchronous orbit which provide S-band Single Access (SSA), S-band Multiple Access (MA), and Ku-band Single Access (KSA) tracking and data communications services to low earth orbiting satellites. The SN will be the primary system for relaying data between most EOS spacecraft and the ground.

The NCC is the focal point for management of the SN and the GN. The NCC is responsible for scheduling of TDRSS operations and the performance of link monitoring and fault isolation. The NCC Data System (NCCDS) consists of three major segments: the Communications and Control Segment (CCS), the Service Planning Segment (SPS), and the Intelligent Terminal Segment (ITS). In addition, a Service Accounting Segment (SAS) is an off-line element that provides accounting for the use of the services and resources of the SN as planned by the SPS. Under certain conditions, as defined by NASA management (such as contingency or emergency situations), the NCC may schedule applicable world-wide U.S. Government communications

networks. The SN is managed by the GSFC Networks Division (Code 530) of the Mission Operations and Data Systems Directorate (MO&DSD) (Code 500).

3.6 Wallops Orbital Tracking Station (WOTS), Alaska Ground Station (AGS) and Svalbard Ground Station (SGS)

The WOTS, located at Wallops Island, Virginia, provides TT&C support for non-TDRSS compatible low earth orbiting satellites and S-band emergency support for TDRSS-compatible satellites, including EOS spacecraft. The Alaska and Norway ground stations will provide this TT&C support and in addition will provide X-band science data capture that will be recorded on magnetic tape will be shipped to EDOS. The WOTS also may be used as a primary means of space/ground communications for certain (non-TDRSS compatible) EOS spacecraft. The WOTS, EPGS~~AGS and SGS~~ is managed by the GSFC Suborbital Projects and Operations Directorate (Code 800).

Scheduling of the WOTS and~~,~~ EPGS for contingency support~~AGS and SGS~~ will be accomplished by the Wallops Flight Center utilizing the Wallops Orbital Tracking Information System (WOTIS). The specific message formats are described in the ICD between the Mission Operations and Data Systems Directorate (Code 500) and the Suborbital Projects and Operations Directorate (Code 800).

3.7 Flight Dynamics Facility (FDF)

The FDF, located at GSFC, provides orbit, attitude, and navigation computational services in support of GSFC flight projects. Pre-launch services include mission design analysis, trajectory analysis, sensor analysis, and operations planning. FDF will interface with ECS to receive orbit and attitude telemetry subsets and to provide operational support services, including orbit and attitude determination, anomaly resolution, orbit adjustment planning and maneuver support, sensor calibration, post mission velocity analysis, and generation of planning and scheduling data products. FDF is managed by the GSFC Flight Dynamics Division (Code 550) of the MO&DSD (Code 500).

~~3.8 Nascom Operational Local Area Network (NOLAN)~~

~~NOLAN is an expansion of the MO&DSD Operational/Development Network (MODNET). NOLAN is a high speed operational local area network (LAN) which supports high speed network communications with MO&DSD hosts. NOLAN provides data communications using standards-based protocols and interfaces, specifically using Fiber Distributed Data Interface (FDDI), ethernet, and the Internet Protocol (IP). The NOLAN supports the transfer of operational data products such as orbit, attitude, ephemeris, and processed data products. NOLAN will be used to transport TRMM science and ancillary data between the GSFC SDPF and the ECS SDPS (at MSFC DAAC and LaRC DAAC). NOLAN is managed by the GSFC Nascom Division (Code 540) of the MO&DSD (Code 500).~~

3.9EOSDIS Backbone Network Communications (EBnet)

The EBnet is a Wide Area Network (WAN) that provides, in combination with other institutional and public networks, connectivity between geographically distributed EOSDIS facilities to support ECS mission operations and data production functions. EBnet is the EOSDIS component that provides the primary communications network for transport of EOS mission critical data. EBnet consists of a Transport Subsystem (TS), a Common Carrier Subsystem (CCS), a Network Management Subsystem (NMS), and an Engineering Support Subsystem (ESS). The TS and the CCS implement the functionality to transport digital data among EBnet users. The TS also includes Frame Encapsulator/Decapsulator (FED) devices which perform User Datagram Protocol/Internet Protocol (UDP/IP) encapsulation and decapsulation of command and telemetry data. EBnet is responsible for transporting spacecraft command, control, and science data nationwide on a continuous basis, 24 hours a day, 7 days a week. The EBnet capability to transport these diverse types of data is implemented as two distinct sub-networks referred to as :real-time" and "science" networks. The real-time network transports mission-critical data related to the health and safety of on-orbit space systems and raw science telemetry as well as pre-launch testing and launch support. The science network transports data collected from spacecraft instruments and various levels of processed science data including expedited data sets, production data sets, and rate-buffered science data. The EBnet WAN will be designed, implemented and maintained by the Nascom organization at GSFC.

3.10 EOS Data and Operations System (EDOS)

EDOS is the EOSDIS component that supports real time and Level 0 data delivery operations for EOS spacecraft. EDOS performs Level 0 data processing, Level 0 Production Data Set (PDS) distribution, and backup data archive services. Communications links between the ECS and EDOS are provided by EBnetEcom.

4. Functional and Performance Interface Requirements

4.1 ~~Requirements Traceability~~(Deleted)

~~The functional and performance interface requirements identified in this document will be traced to the following parent documents:~~

~~a. Functional and Performance Requirements Specification for the ECS~~

~~b. Earth Science Data and Information System (ESDIS) Project — Level 2 Requirements~~

~~Appendix A, Table A-1 of this document provides a listing of each IRD requirement by requirement number and an identification of its parent requirements as found in these documents.~~

4.2 ECS Functional Interface Requirements

The following requirements formally acknowledge the ECS interfaces with the NASA Institutional Support Systems and define interface requirements that will be tested during ECS integration. The following IRD requirements represent Level 3-equivalent interface requirements which have been derived and extracted from the Functional and Performance Requirements Specification for the ECS. Detailed Level 4 requirements specific to each EOS mission (AM-1, PM-1, etc.) will be defined in the ECS Segment Requirements Specification.

4.2.1 TDRSS Interface Requirements

NI-0010 ECS shall have the capability to communicate with the TDRSS via the EDOS/EBnet~~Ecom~~ interface.

NI-0020 ECS shall have the capability to communicate with the TDRSS for transmitting commands to EOS spacecraft (via the EDOS/EBnet~~Ecom~~ interface). Mission-specific requirements for supporting EOS spacecraft command operations will be documented in the EOS mission-level Detailed Mission Requirements documents.

NI-0030 ECS shall have the capability to interface with the TDRSS for obtaining return link (telemetry) data from EOS spacecraft (via the EDOS/EBnet~~Ecom~~ interface). Mission-specific requirements for supporting EOS spacecraft telemetry operations will be documented in the EOS mission-level Detailed Mission Requirements documents.

4.2.2 NCC Interface Requirements

NI-0110 ECS shall have the capability to communicate with the NCC via the EBnet~~Ecom~~ interface.

~~.~~NI-0120 ECS shall have the capability to send TDRSS schedule requests to the NCC. These messages will be defined in the ICD Between the GSFC MOCs and the NCCDS~~1.~~

NI-0130 ECS shall have the capability to receive schedule result messages from the NCC. These messages will be defined in the ICD Between the GSFC MOCs and the NCCDS.

NI-0140 ECS shall have the capability to receive TDRSS schedule messages from the NCC. These messages will be defined in the ICD Between the GSFC MOCs and the NCCDS.

NI-0150 ECS shall have the capability to send other non-telemetry data messages to the NCC, which includes at a minimum status and reconfiguration messages. These messages will be defined in the ICD Between the GSFC MOCs and the NCCDS.

NI-0160 ECS shall have the capability to receive other non-telemetry data messages from the NCC, which includes at a minimum status and reconfiguration messages. These messages will be defined in the ICD Between the GSFC MOCs and the NCCDS.

~~NI-0170 ECS shall have the capability to communicate with the WFF to coordinate support from AGS, SGS, and WOTS for EOS missions. This interface is defined in the ICD between the Mission Operations and Data Systems (Code 500) and the suborbital projects (Code 800).~~

4.2.3 EPGS ~~GN, DSN~~, and WOTS Interface Requirements

NI-0210 ECS shall have the capability to communicate with the AGS, SGS, and WOTS via the EDOS/EBnet~~Ecom~~ interface.

NI-0220 ECS shall have the capability to communicate with the AGS, SGS, and WOTS for transmitting commands to EOS spacecraft (via the EDOS/EBnet~~Ecom~~ interface). Mission-specific requirements for supporting EOS spacecraft command operations will be documented in the EOS mission-level Detailed Mission Requirements documents.

NI-0230 ECS shall have the capability to interface with the AGS, SGS, and WOTS for obtaining return link (telemetry) data from EOS spacecraft (via the EDOS/EBnet~~Ecom~~ interface). Mission-specific requirements for supporting EOS spacecraft telemetry operations will be documented in the EOS mission-level Detailed Mission Requirements documents.

~~1 The *ICD Between the GSFC MOCs and the NCCDS* is currently under development by the NCC Project Office, Code 530. Until this ICD is complete, the *ICD Between the GSFC POCCs and the NCCDS* and the *DFCD Between the GSFC POCCs and the NCCDS* will be considered the defining documents for NCC-ECS message exchange.~~

~~NI-0240 ECS shall have the capability to receive non-telemetry data from the AGS, SGS, and WOTS (via the EDOS/Ecom interface). Mission-specific requirements for supporting EOS spacecraft operations will be documented in the EOS mission-level Detailed Mission Requirements documents.~~

~~NI-0250 ECS shall be expandable to support the capability to communicate with the AGS, SGS, and WOTS to schedule support for EOS spacecraft beyond AM-1 (in accordance with NASA policy and procedures).~~

4.2.4 FDF Interface Requirements

NI-0310 ECS shall have the capability to communicate with the FDF via the EBnet~~Ecom~~ interface.

NI-0330 ECS shall have the capability to send a subset of EOS spacecraft telemetry stream to the FDF, which includes the following:

a. Attitude sensor data

b. Navigation telemetry data

c. Spacecraft maneuver telemetry data

Mission-specific requirements for FDF support of EOS missions will be documented in the EOS mission-level Detailed Mission Requirements documents and FDF-developed ICDs.

NI-0340 ECS shall have the capability to receive planning and scheduling information for the EOS spacecraft and instruments from the FDF.

Mission-specific requirements for FDF support of EOS missions will be documented in the EOS mission-level Detailed Mission Requirements documents and FDF-developed ICDs.

NI-0350 ECS shall have the capability to receive parameters necessary for spacecraft command data generation from the FDF, including the following:

a. Navigational operations parameters

b. Spacecraft maneuver parameters

Mission-specific requirements for FDF support of EOS missions will be documented in the EOS mission-level Detailed Mission Requirements documents and FDF-developed ICDs.

NI-0360 ECS shall have the capability to send a notification of orbit ~~or attitude~~ quality checks and request updated (refined/repaired) orbit ~~or attitude~~ data from the FDF when necessary. Mission-specific requirements for FDF

support of EOS missions will be documented in the EOS mission-level Detailed Mission Requirements documents and FDF-developed ICDs.

NI-0365 ECS shall have the capability to receive from FDF a notification of orbit and/or attitude quality checking software and parameters. Mission-specific requirements for FDF support of EOS missions will be documented in the EOS mission-level Detailed Mission Requirements documents and FDF-developed ICDs.

NI-0370 ECS shall have the capability to receive from FDF, at a minimum the following:

a. Orbit data and associated metadata

b. Attitude data and associated metadata

Mission-specific requirements for FDF support of EOS missions will be documented in the EOS mission-level Detailed Mission Requirements documents and FDF-developed ICDs.

4.2.5 NOLAN Interface Requirements

NI-0400 ECS shall have the capability to interface with NASA Data Processing Facilities (including the GSFC SDPF) via NOLAN to receive the following data (at a minimum):

a. Science data

b. Ancillary data

c. Orbit data

NI-0430 ECS shall have the capability to receive notification of faults in the NOLAN network that may affect the quality of NOLAN services between ECS and its users.

NI-0440 ECS shall have the capability to receive information regarding fault status and estimated time to repair or resolve NOLAN faults that may affect the quality of NOLAN services between ECS and its users.

NI-0450 ECS shall have the capability to receive periodic summary information about faults that may have affected the quality of NOLAN services between ECS and its users.

NI-0460 ECS shall have the capability to receive periodic information regarding NOLAN network performance and link utilization.

NI-0470 ECS shall have the capability to receive notifications of security breaches at NOLAN sites or within the NOLAN network that could potentially affect ECS sites.

~~NI-0480 ECS shall have the capability to send to NOLAN notifications of security breaches at ECS facilities that could affect NOLAN and other EOSDIS sites.~~

4.3 ECS RMA and Performance Interface Requirements

Performance interface requirements for the NASA Institutional Support Systems interfaces with ECS are documented in the Detailed Mission Requirements documents for each EOS mission. Performance requirements also are defined in ICDs developed by the NASA Institutional Support Systems.

The following paragraphs list ECS reliability, maintainability, and availability (RMA) and performance interface requirements derived from the Functional and Performance Requirements Specification for the ECS.

NI-1000 ECS functions shall have an operational availability (computed as defined in the Functional and Performance Requirements Specification for the ECS) of 0.96 at a minimum and a Mean Down Time (MDT) of four (4) hours or less, unless otherwise specified.

NI-1010 The ECS FOS shall have an operational availability of 0.9998 at a minimum and a MDT of one (1) minute or less for critical real time functions that support:

a. Launch

b. Early orbit checkout

c. Disposal

d. Orbit adjustment

e. Anomaly investigation

f. Recovery from safe mode

g. Routine real time commanding and associated monitoring for spacecraft and instrument health and safety

NI-1030 The ECS FOS shall have an operational availability of 0.99925 at a minimum and a MDT of five (5) minutes or less for non-critical real time functions.

NI-1060 The ECS shall contribute a loop delay of not greater than 2.5 seconds of the total system delay of five (5) seconds for emergency real time commands, not including the time needed for command execution. The loop delay is measured from the originator to the spacecraft/instrument and back and only applies when a TDRSS link is available for contact to the spacecraft.

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5. Interface Control Documentation Plan

5.1 Overview

The ICDs which correspond to this IRD are identified in the following paragraphs. Responsibility for development of these documents is specified below. The ECS contractor will support development of these ICDs by reviewing the documents and providing comments and actively participate in the ICD process in a support capacity. These ICDs will be controlled by ESDIS Configuration Control.

5.2 ECS/TDRSS Interface Documents

ECS will interface with TDRSS via EDOS. The ECS interface with EDOS is~~will be~~ documented in the ICD between EDOS and EGS elements. EDOS is responsible for development and maintenance of this ICD. ~~an ICD to be developed by the EDOS Project. The ECS need dates for this ICD are as follows:~~

- ~~Preliminary: June 1995~~
- ~~Final: September 1995~~

~~The EDOS Operations Concept document and EOS mission Detailed Mission Requirements also contain useful descriptive information on the ECS interface with TDRSS through EDOS.~~

5.3 ECS/NCC Interface Documents

The ECS/NCCDS interface is~~will be~~ documented in the ICD Between the GSFC MOCs and the NCCDS. This ICD was ~~is currently being~~ developed by GSFC Code 530, NCC Project Office, and covers the generic interface between the NCCDS for all GSFC missions. ~~The ECS need dates for this ICD are as follows:~~

- ~~Preliminary: Completed~~
- ~~Final: ECS CDR - 1 month (May 1995)~~

Other existing documentation which is useful in describing NCC interfaces are the Operations Interface Procedures Between the NCC and STDN Users, the Space Network User's Guide, and the Space Network User's Guide for Real-Time Operations.

5.4 ECS/AGS-SGS-WOTS Interface Documents

ECS will interface with the AGS, SGS, and WOTS via EDOS. The ECS interface with EDOS is~~will be~~ documented in the ~~an~~ ICD between ~~to be developed by the~~ EDOS and EGS Elements~~Project~~. EDOS is responsible for the development and maintenance of this ICD~~The ECS need dates for the EDOS ICD are listed in Section 5.2~~. Also, the ICD Between Wallops and

GSFC for GSFC Missions Using the WOTS, ~~AGS and SGS~~ defines the existing scheduling and operations interfaces between GSFC and Wallops. A new appendix to this ICD will be developed for each EOS mission, based on requirements documented in the mission Detailed Mission Requirements documents.

These appendixes will be developed under the direction of the GSFC Systems Management Office (Code 502). Approximate need dates for these appendixes are as follows:

- EOS AM:
  - Preliminary: ECS Release A PDR - 1 month
  - Final: ECS Release A CDR - 1 month (May 1995)
- EOS PM:
  - Preliminary: ECS Release C IDR - 1 month (February 1998)
  - Final: ECS Release C CDR - 1 month (September 1998)
- EOS Aero:
  - Preliminary: ECS Release C IDR - 1 month (February 1998)
  - Final: ECS Release C CDR - 1 month (September 1998)
- EOS Alt:
  - Preliminary: ECS Release D IDR - 1 month (April 2000)
  - Final: ECS Release D CDR - 1 month (September 2000)
- EOS Chem:
  - Preliminary: ECS Release D IDR - 1 month (April 2000)
  - Final: ECS Release D CDR - 1 month (September 2000)

Other existing documentation which describe WOTS and~~,~~ EPGS~~AGS and SGS~~ interfaces is the ICD between the Mission Operations Directive (Code 500) and the Suborbital Projects and Operations Directive (Code 800). The EDOS Operations Concept document and EOS Mission Detailed Mission Requirements also contain useful descriptive information on the ECS interface with AGS, SGS, and WOTS through EDOS.

5.5 ECS/FDF Interface Documents

The FDF organization will prepare ICD(s) for each EOS mission, based on requirements documented in the mission Detailed Mission Requirements document. The ECS need dates for these ICDs are as follows:

- EOS AM:
  - Preliminary: ECS Release A PDR - 1 month

  - Final: ECS Release A CDR - 1 month (May 1995)
- EOS PM:
  - Preliminary: ECS Release C IDR - 1 month (February 1998)
  - Final: ECS Release C CDR - 1 month (September 1998)

- EOS Aero:
  - Preliminary: ECS Release C IDR - 1 month (February 1998)
  - Final: ECS Release C CDR - 1 month (September 1998)
- EOS Alt:
  - Preliminary: ECS Release D IDR - 1 month (April 2000)
  - Final: ECS Release D CDR - 1 month (September 2000)
- EOS Chem:
  - Preliminary: ECS Release D IDR - 1 month (April 2000)
  - Final: ECS Release D CDR - 1 month (September 2000)

The ~~Flight Dynamics Division (FDD) Generic Data Product Formats ICD and~~ EOS mission Detailed Mission Requirements also contain<u>s</u> ~~useful descriptive information on the ECS interface with the~~ FDF <u>Requirements</u>.

~~5.6 ECS/NOLAN Interface Documents~~

~~The ECS/NOLAN interface will be designed to requirements found in the NOLAN ICD. This ICD has been developed by GSFC Code 540, Nascom Division, and covers the generic NOLAN interface definition. Appendix A of the NOLAN ICD provides network connection guidelines and an example of a Memoranda of Agreement (MOA) which will be required to define interface details specific to the NOLAN/ECS interfaces. The ECS need dates for this MOA are as follows:~~

- ~~Preliminary: ECS Release A PDR - 1 month~~
- ~~Final: ECS Release A CDR - 1 month (May 1995)~~

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Abbreviations and Acronyms

AGS	Alaska Ground Station ~~(Gilmore Creek)~~
ASF	Alaska SAR Facility
~~ATM~~	~~Asynchronous Transfer Mode~~
CCB	Configuration Control Board
CCR	Configuration Change Request
CCS	~~Common Carrier Subsystem (Ecom),~~ Communications and Control Segment (NCC)
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CSMS	Communications and System Management Segment
DAAC	Distributed Active Archive Center
DCN	document change notice
DFCD	Data Format Control Document
DFRD	Data Format Requirements Document
DID	Data Item Description
DMR	Detailed Mission Requirements
EBbnet	EOSDIS Backbone Network
ECS	EOSDIS Core System
EDC	EROS Data Center
EDOS	EOS Data and Operations System
EGS	EOS Ground System
EOC	EOS Operations Center
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
EPGS	EOS Polar Ground Stations

EROS	Earth Resources Observation System
ESDIS	Earth Science Data and Information System
~~ESN~~	~~EOSDIS Science Network~~
~~ESS~~	~~Engineering Support Subsystem (EBnet)~~
F&PRS	Functional and Performance Requirements Specification
FDD	Flight Dynamics Division
FDDI	Fiber Distributed Data Interface
FDF	Flight Dynamics Facility
~~FED~~	~~Frame Encapsulator/Decapsulator (EBnet)~~
FOS	Flight Operations Segment
~~FPS~~	~~Fiber Protection Switch~~
GSFC	Goddard Space Flight Center
ICC	Instrument Control Center
ICD	Interface Control Document
ICWG	Interface Control Working Group
IDR	Incremental Design review
IP	International Partners, Internet Protocol
IRD	Interface Requirements Document
IST	Instrument Support Terminal
ITS	Intelligent Terminal Segment (NCC)
KSA	Ku-band Single Access
LAN	Local Area Network
LSM	Local System Management
LaRC	Langley Research Center
MA	Multiple Access
MDT	mean down time
~~MODNET~~	~~MO&DSD Operational/Development Network~~

MO&DSD	Mission Operations and Data Systems Directorate (GSFC Code 500)
MOA	Memoranda of Agreement
MOC	Mission Operations Center
~~MSFC~~	~~Marshall Space Flight Center~~
NASA	National Aeronautical and Space Administration
Nascom	NASA Communications Network
NCC	Network Control Center
NCCDS	NCC Data System
~~NMS~~	~~Network Management Subsystem (EBnet)~~
~~NOLAN~~	~~Nascom Operational Local Area Network~~
NSI	NASA Science Internet
NSIDC	National Snow and Ice Data Center
OIP	Operations Interface Procedure
ORNL	Oak Ridge National Laboratory
OSI	Open Systems Interconnection
OSSA	Office of Space Sciences and Applications
PDR	Preliminary Design Review
PDS	Production Data Set
PI	Principal Investigator
POCC	Payload Operations Control Center
PSAT	Predicted Site Acquisition Table
PSCN	Program Support Communications Network
QDS	Quick Look Data Set
RIR	Release Initiation Review
RMA	reliability, maintainability, and availability
SAR	Synthetic Aperture Radar
SAS	Service Accounting Segment (NCC)
SDPS~~F~~	Science Data Processing Segment~~SDPF Sensor Data Processing Facility~~

~~SDPS~~	~~Science Data Processing Segment~~
SDR	System Design Review
SGS	Svalbard Ground Station
SMC	System Monitoring and Coordination ~~Management Center~~
SN	Space Network
SOW	Statement of Work
SPS	Service Planning Segment (NCC)
SRR	System Requirements Review
SSA	S-band Single Access
STDN	Spaceflight Tracking and Data Network
STGT	Second TDRSS Ground Terminal
TBR	To Be Resolved, To Be Reviewed
TBS	To Be Supplied
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System
TGT	TDRSS Ground Terminal
TL	Team Leader
~~TRMM~~	~~Tropical Rainfall Measuring Mission~~
~~TS~~	~~Transport Subsystem (Ecom)~~
TT&C	tracking, telemetry, and command
U.S.	United States
UAV	User Antenna View
UDP/IP	User Datagram Protocol/Internet Protocol
WAN	Wide Area Network
WFF	Wallops Flight Facility
WOTS	Wallops Orbital Tracking Station
WSC	White Sands Complex
WSGT	White Sands Ground Terminal